for the estimation of the radioactivity of mineral waters. A considerable amount of attention is paid to the biological, as distinguished from the bacteriological, examination, and a large number of excellent figures are given of the various species of organisms likely to be met with in waters of various types.

The least satisfactory section is that dealing with the bacteriological examination of water. In particular, the detection and enumeration of the *B. coli communis,* to which so much attention is paid in this country, is treated in an extremely inadequate manner.

Highways and Byways in Lincolnshire. By W. F. Rawnsley. With illustrations by F. L. Griggs. Pp. xx + 519. (London: Macmillan and Co., Ltd., 1914.) Price 5*s.* net.

THIS book maintains the high reputation of the series to which it belongs. Mr. Rawnsley has throughout supposed the tourist to be travelling by motor, and has accordingly said very little about footpaths. Lincolnshire, he says, teems with splendid churches, and that is the first impression received after looking at the admirable illustrations which Mr. Griggs has provided. But attention is by no means confined to ecclesiastical architecture, for the book abounds in anecdotes, gossip, and quaint information. We read that Sir John Franklin, the famous arctic navigator, and Major James Franklin, who made the first military survey of India, were born at Spilsby in this county. On the road from Spalding to King's Lynn the author tells us he passed a field with an unfamiliar crop of stiff purplish plants which showed where the cultivation of *Isatis tinctoria,* the woad plant, which added so much to the attractiveness of our earliest British ancestors, was still kept going. Or, again, at Tothby a plague-stone is to be found, and we are given a bright account of how sufferers from the plague in the seventeenth century were fed without spreading infection. The book will appeal not only to Lincolnshire people, but also to all who love the English countryside.

Les Coordonnés intrinsèques. Théorie et Applications. By Dr. L. Braude. (*Scientia,* No. 37.) Paris: Gauthier-Villars, 1914. Pp. 100. Price 2 francs.

ALTHOUGH quite good in its way, this book does not present any very striking features. It may best be described as a collection of problems most of which could be worked out as exercises by any fairly good English mathematical student. Intrinsic equations are here obtained for the usual well-known plane curves, such as cycloid, catenary, equiangular, spiral, and they are applied to the study of associated loci such as roulettes, Mannheim's curves, pedals, or involutes and evolutes. In England this work is commonly studied in courses rightly or wrongly described as "advanced calculus," but it may be useful to teachers and others to have a book of reference in which the subject is treated separately and in greater detail than in our calculus text-books.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Accumulated Rainfall at Excessive Rates.

IN the *Monthly Weather Review* a table (No. II.) is regularly published giving accumulated amounts of precipitation when the rates equal or exceed:—

Duration	5	10	20	30	60	minutes.
Rate per hour	3·00	1·80	1·20	1·00	0·80	inches.

Unfortunately the headings and the entries are not consistent; and the purpose of the table is defeated by a tabular arrangement in which sense is sacrificed for space. The table misleads American meteorologists, even those of us familiar with the arrangement; and it is therefore not to be wondered at that the most eminent of climatologists, Dr. Julius v. Hann, read for a five-minute interval 4·19 in. of rain when the actual fall was 0·13 in. at Oklahoma, June 30, 1913 (*M.W.R.,* 41·7: 1129, July, 1913).

Prof. Hann directed attention in the *Meteor. Zeitschrift,* of which he is editor, to this remarkable rate (*Meteor. Zeits.,* vol. xxxi., part 4, p. 196), stating that it was the heaviest rainfall on record, and gravely adding that the rate, 21·3 mm. was most remarkable, and that it was scarcely conceivable that so much water could fall from the sky in five minutes.

Dr. Hann should not be held responsible for the error. A correction has been published in a recent number of the review, but few will see it, and in the confusion incident to the war it may escape general notice. We are likely, therefore, to meet the statement in years to come that official records show a rainfall of the rate given above.

With the hope of preventing future misunderstandings, I have appealed to the chief of the Weather Bureau to alter the table, and have further urged that now is an opportune time to abandon the use of inches in measurements of precipitation and use the millimetre. Is it not also high time that British rainfall was expressed, if not indeed measured, in millimetres?

Accumulated amounts at excessive rates are of interest to engineers, and it might be well to substitute for the present values, which are arbitrary and confusing, the following rational units:—

Duration ...	1	5	10	60 minutes.
Rate per hour ...	1	5	10	20 mm.

I add the heaviest known rainfalls and rates with the hope that some of the readers of NATURE will amend.

	Rate per hour	Actual duration of rate
Baguio, P.I., July 14, 1911 ...	49 mm.	24 hours
Campo, Cal., August 12, 1891 ...	219 ,,	80 minutes
Guinea, Va., August 24, 1906 ...	470 ,,	30 ,,
Curtea de Argrea (Roumania), July 7, 1889	615 ,,	20 ,,

ALEXANDER MCADIE.

Blue Hill Observatory, October 12.

Fizeau's Experiment and the Principle of Relativity.

SIR JOSEPH LARMOR has kindly pointed out to me that it is incorrect, in the interpretation of Fizeau's experiment, to assume that the velocity of propagation of light is the group velocity, so that I must withdraw

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the conclusion drawn by me in NATURE of October 22, that Michelson and Morley's repetition of the experiment, when correctly interpreted, is in close agreement with the predictions of the principle of relativity. This being so, it may be worth while to direct attention to certain facts in connection with that experiment which render it quite inconclusive.

(1) On the ground of an experimental device for estimating the pressure gradient at different points of the tube, Michelson and Morley assume that the velocity along the axis is equal to 1·165 times the mean velocity. This is in sharp contradiction with the theory of the flow of liquid in a tube which shows that the axial velocity is twice the mean.

(2) The beam of light which traverses the tubes appears from the figures given to occupy a considerable fraction of the whole area of the tube, and is thus subject to a retardation in phase which varies with the variation of the velocity of the liquid at different distances from the axes. It may be shown that the retardation in phase of the resultant disturbance when brought to a focus is equal to that which would be produced if the velocity of flow were uniform and equal to the mean velocity over the part of the tube occupied. If this were the whole tube the result of applying these corrections would be to increase the result given by Michelson and Morley for the convection coefficient from 0·434 to 0·515. On the other hand, if the diameter of the beam were about 0·93 of the diameter of the tube the mean velocity would be so much greater that the convection-coefficient would be reduced to the theoretical value given by the formula of Lorentz, viz., 0·451. There is thus a possibility of general agreement, but the experiment is quite indecisive.

The announcement that Prof. Zeeman has repeated the experiments with great care and with monochromatic light and has succeeded in observing a dispersive effect is, therefore, of great importance, and his detailed results will be awaited with much interest (Amsterdam Proceedings, September 26).

E. CUNNINGHAM.

St. John's College, Cambridge, October 26.

Flint Fracture.

MR. LEWIS ABBOTT's letter in NATURE of October 22 is almost entirely irrelevant to the subject of my communication to NATURE of September 24. In this note I dealt solely with one form of flint fracture, viz., the large, flat, non-conchoidal fractures, surfaces which are produced by a certain type of "cleaving" blow, and pointed out how it is possible to determine the nature and direction of the fracturing-agent by the recognition of the fissures of varying size radiating from the point of impact. Mr. Abbott, however, states, these "are certainly not fissures"; but an examination of these markings upon a flint and a reference to the meaning of the word "fissure" in a dictionary will convince anyone that my description is correct.

The major part of Mr. Abbott's letter deals with subjects upon which my former note has no bearing, and though I agree that these are important and need investigation, yet it seems regrettable, if the problems they present were, as Mr. Abbott infers, in process of solution several years ago, that the knowledge already acquired at that time has not up to the present been laid before the scientific world. It is to be hoped that Mr. Abbott may be able to induce the collector who interviewed the late Sir John Evans to do so without delay.

J. REID MOIR.

12 St. Edmund's Road, Ipswich, October 23.

TOWARDS NATURE-STUDY.[1]

(1) PROF. ABBOTT'S aim is to give "a simple statement of the fundamentals of General Biology," both for the general reader and the laboratory student. He deals with both plants and animals, shifting his field so as to get the best illustrations. The main subjects discussed are—living substance, the primary functions, metabolism, growth, differentiation, development, variation and heredity, organic response, species and their origin. The book is well-illustrated and marked by three other qualities—an admirable clearness which points to teaching experience, a pleasant freshness of treatment which is in part due to the numerous references to recent work, and an all-roundness of survey, for almost every aspect of biology is at any rate recognised and illustrated. This third quality lays the book open to the disadvantage of sometimes saying too little, but most introductory books of this sort say far too much. But we should have liked, for instance, to know more about those sea birds which "lay their eggs on the bare rocks and pay no more attention to them thereafter."

(2) Prof. J. R. Ainsworth-Davis is a firm believer in the value of "nature-study" as a factor in increasing efficiency, and his book—an outcome of large experience—is meant to indicate how the subject may be best dealt with, especially in country schools. After clearly indicating how arithmetic, for instance, may be made vital in the country schools by being applied to actual problems, he proceeds to show this is even more essential in connection with nature-study. For this reason the book gives prominence to common plants and animals and familiar physical phenomena. In regard to the part dealing with plants and animals, however, it appears to us that the author falls far short of his counsel, telling too much and suggesting too little. It is good pemmican, but it is pemmican. In his introduction he protests against the "informational obsession," and upholds "the educational ideal";

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[1] (1) "The Elementary Principles of General Biology." By Prof. J. F. Abbott. Pp. xvi+329. (New York: The Macmillan Co. London: Macmillan and Co., Ltd., 1914.) Price 6*s*. 6*d*.

(2) "The Pursuit of Natural Knowledge." By Prof. J. R. Ainsworth-Davis. Pp. iv.+234. (Cheltenham: Norman, Sawyer and Co., Ltd., 1914.) Price 1*s*. net.

(3) "Animal Life by the Sea-shore. By Drs. G. A. and C. L. Boulenger. Pp. xii+83+plates. (London: Offices of *Country Life, Ltd.*, n.d.) Price 5*s*. net.

(4) "The Naturalist at the Sea-shore." By R. Elmhirst. Pp. viii+86+8 plates. (London: A. and C. Black, 1913.) Price 1*s* 6*d*. net.

(5) "Bird Studies in Twenty-four Lessons." By W. P. Westell. Pp. xii+152. (Cambridge: University Press, 1914.) Price 2*s*. 6*d*. net.

(6) "Common British Beetles." By Rev. C. A. Hall. Pp. vii+86. (London: A. and C. Black, 1914.) Price 1*s*. 6*d*. net.

(7) "Odd Hours with Nature." By Alexander Urquhart. Pp. 323+plates. (London: T. Fisher Unwin, n.d.) Price 5*s*. net.

(8) Ernst Haeckel: "Die Natur als Künstlerin." Nebst: Dr. W. Breitenbach; "Formenschatz der Schöpfung." Pp. 114. (Berlin: Ch. Vita, Deutsches Verlaghaus, n.d.)

(9) "A Natural History of Bournemouth and District," including Archæology, Topography, Municipal Government, Climate, Education, Fauna, Flora and Geology. By the Members of the Bournemouth Natural Science Society. Edited by Sir Daniel Morris. Pp. xiv−400. (Bournemouth: Natural Science Society, 1914.) Price 2*s*. 6*d*. net.

(10) "Handbuch der naturgeschichtlichen Technik für Lehrer und Studierende der Naturwissenschaften." Herausgegeben von Prof. Bastian Schmid. Pp. viii+555. (Leipzig and Berlin: B. G. Teubner, 1914.) Price 15 marks.

(11) "Biologen-Kalender." Edited by Prof. B. Schmid und Dr. C. Thesing. Erster Jahrgang. Pp. ix+513. (Leipzig and Berlin: B. G. Teubner, 1914). Price 7 marks.

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